TERMINAL-EDGE REFINEMENT ALGORITHMS: A STUDY ON A 3-DIMENSIONAL IMPLEMENTATION

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Longest-edge refinement algorithms have been successfully used in practice for performing both adaptive and parallel finite element computations in two and three dimensions [1,2]. In two dimensions it is known in advance the worst aspect ratio that will result from the iterative arbitrary refinement of an initial mesh [3]. Even when there is not yet a proof of this property in three-dimensions, the aspect ratio of the elements does not significantly deteriorate when using longest-edge algorithms for mesh refinement [2] .

In this paper we discuss a 3-dimensional mesh refinement tool which uses a terminal-edge refinement algorithm. This is an improved algorithm that constructs the same meshes than previous longest-edge refinement algorithms by performing very local refinement operations [4,5]. To this end both the terminal-edge and Lepp concepts are used. A terminal-edge l is a special edge in the mesh such that l is the longest-edge of every element in the mesh that shares the edge l. The Lepp (longest-edge propagation path) is a searching path that for any target tetrahedron t to be refined, allows to find an associated set of terminal-edges in the current mesh, which together with is surrounding elements are then refined in the mesh. The searching and refinement steps are repeatedly done until the target tetrahedron is refined in the mesh. Several implementation variations of these ideas can be considered.

Some design and implementation issues are discussed. A graphical interface which allows the easy management of the interactive refinement task is described. The data structure considers two essential neighborhood relations: to each tetrahedron its four neighbor tetrahedra an its corresponding longest-edge l are associated, while that to each edge, the set of its neighboring tetrahedra is associated. A study on the behavior of the algorithm, data structure and some implementation variations, as well as a discussion on the potential parallelization of the algorithm, are also included.

References
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